

REMARKS

Independent claims 1, 2, 19, 21, 22, 23 and 24 have all been amended to set forth *a pressure groove having a radius of curvature larger than the radius of curvature at which the optical fiber breaks*. Support for these amendments is provided at page 31, line 26 to page 32, line 12 of the specification.

As described in the specification, the pressure groove in the wiring head is dimensioned both to prevent the optical fiber from slipping out of the head and to support the optical fiber in a state in which it is bent by a fixed amount and is pressed onto the wiring substrate. As such, the pressure groove is formed with a radius of curvature larger than the radius of curvature at which the optical fiber breaks. Such structure is very effective for wiring the optical fiber (which typically breaks easily when bent). Thus, it is possible to prevent the lead end of the wiring head and an adhesive layer of the wiring substrate from coming into contact during wiring since there is no play in the optical fiber at the lead end of the wiring head.

New Claims 26 and 27:

The Applicants hereby add new dependent claims 26 and 27. Support for these claims is found at page 31, line 26 to page 32, line 12 of the specification.


Conclusion:

In view of the forgoing, the Applicant believes all pending claims to be in condition for allowance. Therefore, the issuance of a Notice of Allowance is respectfully requested.

The Examiner is invited to call the undersigned attorney at the number listed below should he believe a telephone conference would advance prosecution of the present application.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

By: 
David R. Heckadon
Registration No. 50,184

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. (Twice Amended) An optical fiber wiring apparatus for wiring a wiring substrate, comprising:
 - a wheel-less wiring head which guides an optical fiber to a lead end thereof along a guide groove through which the optical fiber slides into position on the wiring substrate, the guide groove extending partially along a length of the wiring head and forming an optical fiber path;
 - an optical fiber feed means which feeds said optical fiber during the wiring operation into said optical fiber path of said wiring head;
 - an optical fiber contacting means, which brings [an]said optical fiber, which has been guided to said lead end of said wiring head via said optical fiber path, and said wiring substrate into contact, wherein the optical fiber contacting means includes an optical fiber pressing means for pressing said optical fiber against said wiring substrate with a predetermined pressure;
 - an XY movement means, which moves said wiring substrate and said wiring head relative to one another in the X and Y directions in the state in which said optical fiber at said lead end of said wiring head has been placed in contact with said wiring substrate by said optical fiber contacting means; and
 - an optical fiber affixing means, which successively affixes, to said wiring substrate, said optical fiber which has been brought into contact with said wiring substrate during movement by said XY movement means wherein in the wheel-less wiring head, a pressure groove connected to said guide groove is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks, so as to support the optical fiber in a state in which it is bent by a fixed amount and is pressed onto said wiring substrate.
2. (Amended) An optical fiber wiring apparatus in accordance with claim 1, wherein
 - [an]said optical fiber within [an]said optical fiber path of said wiring head is successively drawn out when the optical fiber at the lead end of said wiring head is successively affixed by said optical fiber affixing means, and
 - said optical fiber feed means feeds said optical fiber stocked in said optical fiber path which successively draws out said optical fiber.
3. (Twice Amended) An optical fiber wiring apparatus in accordance with claim 1, wherein
 - at least a lead end of said wiring head has a hemispherical shape and the guide groove [which] guides said optical fiber [in]to the hemispherical part,
 - [a]said pressure groove [is formed which is connected to said guide groove and extends to] is formed in said hemispherical part, and
 - said optical fiber is guided to the lead end of said wiring head via said guide groove and said pressure groove.

4. Canceled

5. (As filed) An optical fiber wiring apparatus in accordance with claim 2, wherein
said optical fiber feed means is provided with a deflection detection means for detecting deflection of said optical fiber within said optical fiber path of said wiring head or in a path leading to this optical fiber path, and
a deflection maintaining means for maintaining the deflection within a predetermined range based on detection values of said deflection detection means.

6. (As filed) An optical fiber wiring apparatus in accordance with claim 1, wherein
said optical fiber feed means feeds an amount of optical fiber necessary during various successively executed wirings successively into the optical fiber path of said wiring head.

7. (As filed) An optical fiber wiring apparatus in accordance with claim 6, wherein
said optical fiber feed means is provided with a reverse rotation prevention means which prevents back feeding of said optical fiber and which conducts drawing out of the optical fiber in the direction of feeding without resistance.

8. (As filed) An optical fiber wiring apparatus in accordance with claim 7, wherein
said reverse rotation prevention means is a one-way clutch.

9. (As filed) An optical fiber wiring apparatus in accordance with claim 1, wherein
said optical fiber contacting means is provided with a Z axis actuator which displaces said wiring head in a Z axial direction, and displaces said wiring head in the direction of said wiring substrate and brings an optical fiber at the lead end of said wiring head into contact with said wiring substrate.

10. (Amended) An optical fiber wiring apparatus in accordance with claim 9, wherein the predetermined pressure with which said optical fiber pressing means presses said optical fiber at a lead end of said wiring head against said wiring substrate is within a range of 9.8×10^{-2} (N) (10 gf) - 2.0 N (200 gf).

11. (As filed) An optical fiber wiring apparatus in accordance with claim 1 wherein
at least a part within said optical fiber path of said wiring head which comes into contact with said optical fiber comprises a material having a lower coefficient of friction than said optical fiber.

12. (As filed) An optical fiber wiring apparatus in accordance with claim 1, wherein

in said optical fiber path of said wiring head, at least a portion which guides said optical fiber to the lead end thereof is formed with a radius of curvature larger than the radius of curvature causing breakage of said optical fiber.

13. (As filed) An optical fiber wiring apparatus in accordance with claim 3, wherein

a Z axial rotation means, which rotates said wiring head about the Z axis in accordance with a wiring pattern, and orients said pressure groove of said wiring head in a direction in which wiring is to be conducted during the wiring operation, is provided.

14. (As filed) An optical fiber wiring apparatus in accordance with claim 13, wherein

said Z axial rotation means is provided with a rotational reference sensor for orienting said pressure groove of said wiring head in the direction in which wiring is to be conducted.

15. (As filed) An optical fiber wiring apparatus in accordance with claim 1, wherein

an optical fiber cutting means for cutting said optical fiber to a predetermined length is provided.

16. (As filed) An optical fiber wiring apparatus in accordance with claim 15, wherein

said optical fiber cutting means is provided with:
an optical fiber path into which said optical fiber is inserted,
a cutter disposed so as to be capable of movement in a direction crossing said optical fiber path, and
an electromagnetic slider which moves said cutter instantaneously in a direction crossing said optical fiber path.

17. (As filed) An optical fiber wiring apparatus in accordance with claim 1, wherein

said XY movement means moves said wiring head and wiring substrate relative to one another so that said wiring head is positioned outside said wiring substrate;

said optical fiber feed means feeds a predetermined length of said optical fiber when said wiring head is positioned outside said wiring substrate, and

by means of this, a predetermined length of optical fiber is fed outside said wiring substrate.

18. (As filed) An optical fiber wiring apparatus in accordance with claim 17, wherein

a table which supports said wiring substrate and which has drop holes in the vicinity of said wiring substrate support part is provided, and
a predetermined length of optical fiber is fed into said drop holes of said table and a predetermined length of optical fiber is fed out outside of said wiring substrate.

19. (Twice Amended) An optical fiber wiring apparatus which lays optical fibers down on a wiring substrate, comprising:

a manipulator which is disposed in a plane which is approximately parallel to the surface of said wiring substrate in a movable manner, and which conducts the laying operation of the optical fibers on said wiring substrate, the manipulator comprising:

an optical fiber feed means for feeding an optical fiber;

a wheel-less wiring mechanism for wiring, onto said wiring substrate, said optical fiber fed by said optical fiber feed means, wherein the wiring mechanism includes an optical fiber pressing means for pressing said optical fiber against said wiring substrate with a predetermined pressure;

a Z axial rotation mechanism which rotates about an axis approximately perpendicular to the surface of said wiring substrate and thereby changes the orientation of the wiring of said wiring mechanism; and

an optical fiber cutting means which cuts said optical fiber fed by said optical fiber feed means wherein in the wheel-less wiring mechanism, said optical fiber is supported by a pressure groove in a state in which it is bent by a fixed amount and is pressed onto said wiring substrate, where said pressure groove is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks.

20. (Amended) An optical fiber wiring apparatus in accordance with claim 19, wherein

said wiring mechanism is disposed so as to be movable in a direction of approach to or separation from said wiring substrate, and said wiring mechanism includes a wiring plunger which presses said optical fiber against said wiring substrate by using said optical fiber pressing means while guiding said optical fiber in a predetermined orientation, and

said optical fiber feed means and said wiring plunger are disposed so as to hold said optical fiber cutting means therebetween in the Z axial direction, and are disposed so as to be simultaneously rotatable by said Z axial rotation means.

21. (Twice Amended) A wiring method which conducts the wiring of an optical fiber onto a wiring substrate, comprising:

adjusting the feeding of the optical fiber by an optical fiber feed means so that the tension on the optical fiber is within a fixed range;

wiring the optical fiber fed by the optical fiber feed means onto the wiring substrate by a wheel-less wiring mechanism while the optical fiber is guided along a guide groove formed in the wiring mechanism and is pressed against the wiring substrate with a predetermined pressure; and

cutting the optical fiber to a required length for the wiring by an optical fiber cutting means wherein in the wheel-less wiring mechanism, said optical fiber is supported by a pressure groove in a state in which it is bent by a fixed amount and is pressed onto said wiring substrate, where said pressure groove is connected to said guide groove and is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks.

22. (Twice Amended) An optical fiber wiring method which employs an optical fiber wiring apparatus which is provided with a wiring substrate, a wheel-less wiring head which has a guide groove along which an optical fiber is guided, and applies an the optical fiber to said wiring substrate with a predetermined pressure, and an optical fiber feed means which feeds stocked optical fiber, which apparatus moves said wiring substrate and said wiring head relative to one another in the XY directions and conducts wiring operations which form a desired optical fiber wiring pattern on said wiring substrate, comprising;

feeding an optical fiber of predetermined length by said optical fiber feeding means, in a manner unrelated to the wiring, either before or after the wiring operation or both before and after the wiring operation, and thereby producing an optical wiring board having optical fibers of a predetermined length connected to said wiring pattern either before or after said wiring pattern by means of the wiring operation or both before and after said wiring pattern wherein in the wheel-less wiring head, said optical fiber is supported by a pressure groove in a state in which it is bent by a fixed amount and is pressed onto said wiring substrate, where said pressure groove is connected to said guide groove and is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks.

23. (Twice Amended) An optical fiber wiring method which employs an optical fiber wiring apparatus which is provided with a wiring substrate, a wheel-less wiring head which is provided with an optical fiber path which guides an optical fiber to a lead end thereof and which applies said optical fiber guided to said lead end to said wiring substrate with a predetermined pressure, and an optical fiber feeding means which feeds stocked optical fiber, which apparatus moves said wiring substrate and said wiring head relative to one another in the XY directions and conducts a wiring operation which forms a predetermined optical fiber wiring pattern on said wiring substrate, comprising:

at the initiation of wiring, moving said wiring head to a wiring initiation position, and

in the state in which said optical fiber has been guided to said lead end of said wiring head along a guide groove formed in the wiring head, pressing said optical fiber against said wiring substrate with said predetermined pressure,

wherein said wiring head is moved along said wiring pattern with respect to said wiring substrate, the required optical fiber is fed into said optical fiber path of wherein said wiring head by said optical fiber feeding means, and wiring is conducted; and

in the wheel-less wiring head, said optical fiber is supported by a pressure groove in a state in which it is bent by a fixed amount and is pressed onto said wiring substrate, where said pressure groove is connected to said guide groove and is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks.

24. (Twice Amended) An optical fiber wiring method in which an optical fiber is laid on a wiring substrate by a wheel-less wiring head, at least a lead end of which is formed with a spherical surface, which has formed in a side surface part thereof a guide groove which guides an optical fiber to said spherical surface part, and which has a pressure groove which extends from said guide groove to the top part of said spherical surface part, comprising;

at the initiation of wiring, moving said wiring head to a wiring initiation position;
fitting an optical fiber into said pressure groove;
pressing the optical fiber against said wiring substrate with a predetermined pressure; and

moving said wiring head along said wiring pattern with respect to said wiring substrate to thereby conduct said wiring wherein said pressure groove is formed with a radius of curvature larger than the radius of curvature at which said optical fiber breaks.

25. (As filed) An optical fiber wiring method in accordance with claim 24, wherein

when a wiring pattern to be wired is a curved pattern, said pressure groove of said wiring head is oriented in a direction at tangent to said wiring pattern.

26. (New) An optical fiber wiring apparatus in accordance with claim 1, wherein said guide groove has a deeper portion for inserting said optical fiber, so as to facilitate the insertion of the lead end of the optical fiber.

27. (New) An optical fiber wiring apparatus in accordance with claim 1, wherein said pressure groove is formed so as to become narrower and shallower as it approaches the lead end of the wheel-less wiring head.